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RRC-39
STATISTICAL ANALYSIS
OF ROADARM MOTION

by

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and

James Thero

Systems Simulation Branch

January, 1967

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SYSTEMS SIMULATION BRANCH

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ABSTRACT

A statistical analysis of the lead roadarm motions for a medium tank was performed. The reduction of vibration data describes peak values and time within level. The raw data was obtained from magnetic tapes of suspension performance over the Aberdeen Proving Ground six inch washboard and Perryman cross-country No. 3.

DISCUSSION

A statistical analysis of cross-country lead road-wheel displacement data for a medium tank, was performed by the Systems Simulation Branch. The data was recorded on magnetic tape at the Aberdeen Proving Ground using the Friction Hydropneumatic Test Rig No. 3.

The following equipment was used for the data reduction:

1. Fourteen channel magnetic tape recorder, I14342
2. Analog Computer
3. Buffer Amplifier
4. Output Amplifier
5. D. C. Power Supply
6. Peak Distribution Analyzer, IL1140

The data was reduced for the following cases:

1. 6" Washboard peak count and time in range for 7 MPH, 12 MPH, and maximum speed.
2. Perryman No. 3 peak count and time in range for 7 MPH and 12 MPH runs.

The magnetic tape recorder, analog computer, and amplifiers were used for reproducing and scaling the data for peak distribution. The analyzer performed counts of the number of peaks occurring within preset intervals and the time the data signal spent within various categories. A detailed description of peak and time counts is given in the following paragraph applied to the example waveform as shown in Figure 1.

Figure #1 shows a signal input with peaks and valleys. For a count measurement of the peak at point 1, the signal must increase from A, in category 5, through 6, and to point B, in category 7, but not to point C, in category 8. It must then decrease through 6 and into category 5 again. The count will be in category 7. Point 2 valley will not count. Although the decreasing signal crosses one or more categories, the increasing signal afterward goes only from category 3 to 4 and then decreases again. To count as a valley, this portion of the signal would have to enter category 5. Likewise, the signal at 3 would have to enter category 5 to count as a peak. The point 4 valley will count as it crosses from 4 through 3, into 2, and raises again past 3. Categories 5 through 12 count only peaks. Category size is selected to get the best fit for the data available.

The time count on the data shows the time the input signal spends in each category. The time figures given in the summary are actual accumulated time in milliseconds.

Category

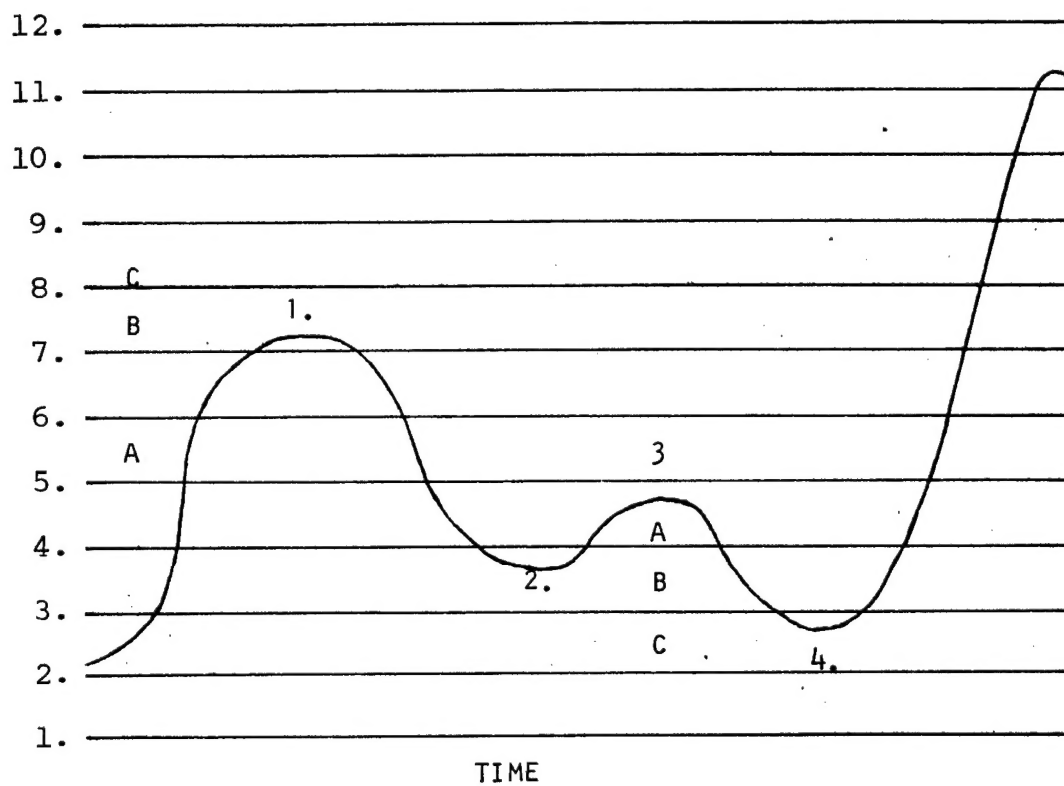


Fig. 1

RESULTS

The results are tabulated on the following four pages. Table No. 1 contains the number of peaks in the ranges designated. Table No. 2 contains the time in milliseconds for the 6" Washboard Course. Table No. 3 contains the count readings on Perryman No. 3 and Table No. 4 contains the time in range. All data is for the displacement of the lead roadarm. The vehicle runs were to be made at maximum vehicle height with 69° of wheel travel from static to bump. However, in examining the data, it was found that the vehicle actually was run with approximately 63° of wheel travel.

The approximate data run times were as follows:

	<u>6" Washboard</u>	<u>Perryman Cross-Country #3</u>
7 MPH	1.25 min.	43 min.
12 MPH	.74 min.	36 min.
Max.	.69 min.	---

6" WASHBOARD COURSE

Peak Count In Range

<u>RANGE</u>	<u>S P E E D</u>		<u>RANGE</u>	<u>MAX. SPEED</u>
	<u>7MPH</u>	<u>12MPH</u>		
Over 22.4°	YES	NO	Over 11.2°	NO
19.6° to 22.4°	2	0	9.8° to 11.2°	0
16.8° to 19.6°	30	2	8.4° to 9.8°	1
14° to 16.8°	70	23	7.0° to 8.4°	1
11.2° to 14°	32	77	5.6° to 7.0°	2
8.4° to 11.2°	1	30	4.2° to 5.6°	17
5.6° to 8.4°	9	0	2.8° to 4.2°	46
2.8° to 5.6°	0	2	1.4° to 2.8°	47
0° to 2.8°	0	0	0° to 1.4°	15
-2.8° to 0°	133	133	-1.4° to 0°	2
-5.6° to -2.8°	1	1	-2.8° to -1.4°	102
-8.4° to -5.6°	0	0	-4.2° to -2.8°	26
-11.2° to -8.4°	0	0	-5.6° to -4.2°	3
Under -11.2°	NO	NO	Under -5.6°	NO

Table 1

6" WASHBOARD COURSE

TIME IN RANGE

RANGE	S P E E D		RANGE	MAX. SPEED Time, ms
	7 MPH Time, ms	12 MPH Time, ms		
Over 31.8°	NO	NO	Over 14°	NO
28.0° to 31.8°	0	0	12.6° to 14°	0
25.2° to 28°	0	0	11.2° to 12.6°	0
22.4° to 25.2°	60	0	9.8° to 11.2°	0
19.6° to 22.4°	182	0	8.4° to 9.8°	26
16.8° to 19.6°	1043	233	7.0° to 8.4°	50
14° to 16.8°	6889	2016	5.6° to 7.0°	141
11.2° to 14°	10915	7906	4.2° to 5.6°	588
8.4° to 11.2°	6808	8064	2.8° to 4.2°	2410
5.6° to 8.4°	6628	6001	1.4° to 2.8°	4705
2.8° to 5.6°	11223	5129	0° to 1.4°	4634
0° to 2.8°	11715	4854	-1.4° to 0°	17164
-2.8° to 0°	19583	10412	-2.8° to -1.4°	11542
Under -2.8°	NO	NO	Under -2.8°	NO

Table 2

PERRYMAN CROSS-COUNTRY #3

Peak Count in Range

<u>RANGE</u>	<u>S P E E D</u>		<u>RANGE</u>	<u>S P E E D</u>	
	<u>7MPH</u>	<u>12MPH</u>		<u>7 MPH</u>	<u>12 MPH</u>
Over 56°	NO	NO	Over 28°	YES	YES
49° to 56°	0	0	24.5° to 28°	7	20
42° to 49°	0	0	21° to 24.5°	22	21
35° to 42°	0	2	17.5° to 21°	26	9
28° to 35°	6	15	14° to 17.5°	18	20
21° to 28°	25	39	10.5° to 14°	10	14
14° to 21°	45	26	7° to 10.5°	14	6
7° to 14°	19	13	3.5° to 7°	9	5
0° to 7°	0	0	0° to 3.5°	1	0
-7° to 0°	88	92	-3.5° to 0°	96	82
-14° to -7°	0	1	-7° to -3.5°	1	1
-21° to -14°	0	1	-10.5° to -7°	0	0
-28° to -21°	0	0	-14° to -10.5°	0	0
Under -28°	NO	NO	Under -14°	NO	NO

Table #3

PERRYMAN CROSS-COUNTRY NO. 3

Time in Range

RANGE	SPEED		12 MPH Time, ms	RANGE	S P E E D	
	7 MPH Time, ms	NO			7 MPH Time, ms	12 MPH Time, ms
Over 77°	NO	NO	NO	Over 38.5°	NO	YES
70° to 77°	0	0	0	35° to 38.5°	30	1265
63° to 70°	0	0	0	31.5° to 35°	1384	2836
56° to 63°	0	0	0	28° to 31.5°	3131	4971
49° to 56°	0	0	0	24.5° to 28°	5415	8723
42° to 49°	0	0	0	21° to 24.5°	12299	11180
35° to 42°	122	1765	1765	17.5° to 21°	16673	10591
28° to 35°	4547	7922	7922	14° to 17.5°	18679	16415
21° to 28°	18007	18877	18877	10.5° to 14°	25535	18655
14° to 21°	35303	29188	29188	7° to 10.5°	26208	18947
7° to 14°	51694	37900	37900	3.5° to 7°	29515	19426
0° to 7°	80124	47866	47866	0° to 3.5°	43740	28001
-7° to 0°	68907	71078	71078	-3.5° to 0°	73090	70911
Under -7°	NO	YES	YES	Under -3.5°	NO	YES

Table 4